

Display Next Hackfest Recap

Daniel Stone

daniels@collabora.com



COLLABORA

Open First



What is Display Next?

Displays are people too

- Gathering of window system and display driver developers
- Represent display hardware to its fullest capability
- Rudimentary Advanced colour management
- Efficiency through hardware offload
- Capability from new connector standards (HDMI, DP, DSI, ...)
- Expose all this up from KMS to userspace
- Expose all this up from compositor to clients



COLLABORA

Colour management



COLLABORA

~~Colour management~~ Gaslighting

HDR remains harder

- Complex colour processing in modern hardware: 16+ blocks
- User expectation: I HAVE HDR JUST PLAY THE HDR THANKS
- See Harry's 'HDR is harder' talk from a few years ago
- Surface the capability common to all hardware (lololol)
- Give the compositor the ability to describe the colour transforms it needs to get content looking good
- Hooray, done

Hardware is harder

- Is all your input really RGB, or is it going through YUV transform?
- What *is* that RGB transform?
- When does that RGB transform get applied?
- What happens *after* blending?
- What gets dumped *on* to the connector?
- What happens *inside* the display?

Hardware is harder

- Is all your input really RGB, or is it going through YUV transform?
- What *is* that RGB transform?
- When does that RGB transform get applied?
- What happens *after* blending?
- What gets dumped *on* to the connector?
- What happens *inside* the display?
- Ehhhhh ...

Describing the chain of pain

- `drm_colorops` for colour model transforms (YUV → RGB)
- `color format` property for what goes on the wire (YUV/RGB, 444/422/420)
- `min bpc` for what goes on the wire (8/10/12bpc)
- Compression?!
- HDR metadata to control display transforms

Describing the chain of pain

- `drm_colorops` for colour model transforms (YUV → RGB)
- `color format` property for what goes on the wire (YUV/RGB, 444/422/420)
- `min bpc` for what goes on the wire (8/10/12bpc)
- Compression?!
- HDR metadata to control display transforms
- Outputs happily ignore everything and just MAKE IT LOUD
- Source-Based Tone Mapping is one way to do this
- So is FreeSync HDR ... ?!

Wait, you can't do any of this yet

- Supporting HDMI 2.x has been a long and un-fun journey
- Started support for HDMI 2.0 and 2.1 features through 2025
- Reverse-engineered / dumpster-dived implementation
- Huge progress through HDMI helper code and Rockchip implementation
- Mandatory to support various colour-management features
- EDID is impressively baroque





Display timing

When will it get there?

- Maybe in 24 weeks
- Or maybe in 24/1.001 weeks ... !
- Accurate display timing is super-critical for media
- Integer rates are too lossy to use properly
- Integer intervals are ... also too lossy to use properly
- Media demands n/d presentation rates
- This is encoded into HDMI 2.1 QMS (aka 'media VRR')
- New uAPI and implementations on list
- Wayland implementation posted

Can we get it faster?

- 10kHz displays: coming soon to a desk near you



Can we get it faster?

- 10kHz displays: coming soon to a desk near you
- ?!

Can we get it faster?

- 10kHz displays: coming soon to a desk near you
- ?!
- KMS was very much designed for 60-120Hz
- Cannot be pipelined: queue depth 1, non-replaceable
- Good luck turning everything around within 1ms
- Oh, and we don't know when the deadline is
- We have absolutely no good conclusions



Display standards

What about other displays?

- DisplayPort has its own standards for all of this
- They are apparently less baroque
- DSI is straightforward and uninteresting
- Unless you want to gang two DSI links together to make a single link
- Your one CRTC is now two CRTCs, but userspace doesn't know that
- `drmModeAtomicCommit` has two return codes: 0 and `EINVAL`
- Can we do better?

Standards: ¿por qué no los dos?

- We make our own lives exciting by chaining them
- Every* display involves multiple standards
- Most laptops have a bridge IC to handle e.g. DSI → HDMI
- What if your bridge IC could be hotplugged?

Standards: ¿por qué no los dos?

- We make our own lives exciting by chaining them
- Every* display involves multiple standards
- Most laptops have a bridge IC to handle e.g. DSI → HDMI
- What if your bridge IC could be hotplugged?
- Most of this is handled out-of-band with I²C
- Firmware updates also get handled over DP auxch
- What happens if your KMS driver is trying to use auxch?
- Errrrr ... yeah ok

Standards: ¿por qué no los dos?

- We make our own lives exciting by chaining them
- Every* display involves multiple standards
- Most laptops have a bridge IC to handle e.g. DSI → HDMI
- What if your bridge IC could be hotplugged?
- Most of this is handled out-of-band with I²C
- Firmware updates also get handled over DP auxch
- What happens if your KMS driver is trying to use auxch?
- Errrrr ... yeah ok
- (Also your display is competing with USB for bandwidth)

Backlight not gaslight

- On laptops, mostly controlled out of band (ACPI, separate PWM)
- External displays might be able to control via auxch
- Just throw everything at userspace: do DDC-CI yourself!

Backlight not gaslight

- On laptops, mostly controlled out of band (ACPI, separate PWM)
- External displays might be able to control via auxch
- Just throw everything at userspace: do DDC-CI yourself!
- Which display does this DDC-CI bus refer to?

Backlight not gaslight

- On laptops, mostly controlled out of band (ACPI, separate PWM)
- External displays might be able to control via auxch
- Just throw everything at userspace: do DDC-CI yourself!
- Which display does this DDC-CI bus refer to?
- Errrrrr ... yep.

Backlight not gaslight

- On laptops, mostly controlled out of band (ACPI, separate PWM)
- External displays might be able to control via auxch
- Just throw everything at userspace: do DDC-CI yourself!
- Which display does this DDC-CI bus refer to?
- Errrrrr ... yep.
- What if we had *some kind* of backlight control in KMS?



Misc and other

A random grab bag of stuff

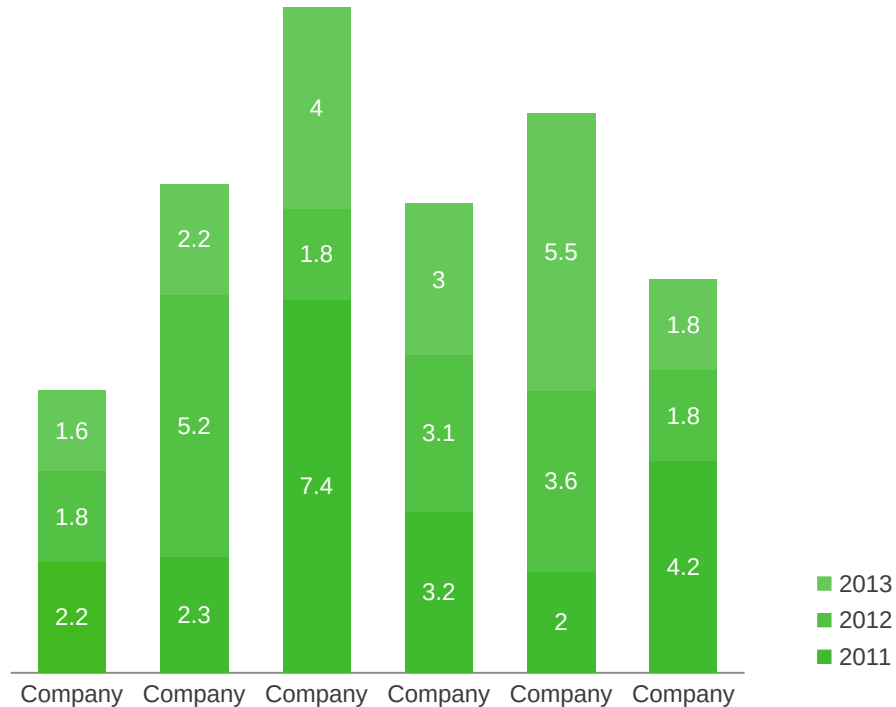
- True multi-GPU is now a lot better on Wayland
- Older AMD GPUs are now a lot better everywhere
- We have no forum to get together and discuss this stuff
- Most of us aren't members of VESA or HDMI Forum
- Even if we were, they stop way below where we need to standardise
- Making huge progress on supporting modern/complex display tech, and surfacing it to generic userspace
- Raise the bar, raise the bar, raise the bar

Pictures of cars



Number go vroom

Slide content paragraphs
With or without bullets

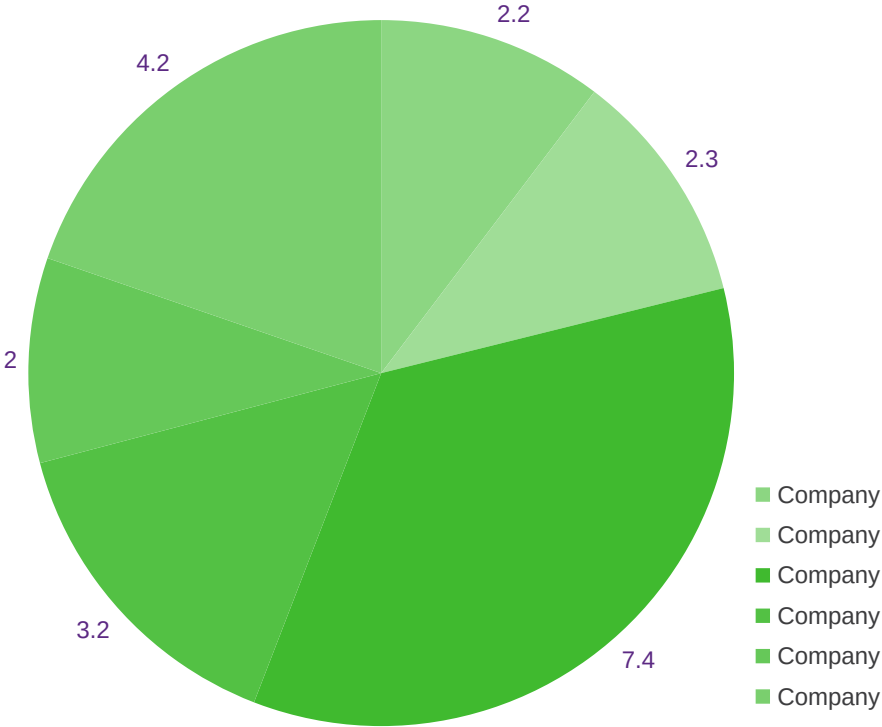


COLLABORA

Open First

I've never liked this gradient scheme

Slide content paragraphs
With or without bullets





Thank you!



COLLABORA

Open First